

ROUND 17

TOSS-UP

1) PHYSICAL SCIENCE *Multiple Choice* When magnesium and zinc bromide are combined, zinc and magnesium bromide are formed according to the reaction, $\text{Mg} + \text{ZnBr}_2 \rightarrow \text{Zn} + \text{MgBr}_2$. Which of the following types of reactions has occurred:

- W) synthesis
- X) combustion
- Y) single replacement
- Z) double replacement

ANSWER: Y) SINGLE REPLACEMENT

BONUS

1) PHYSICAL SCIENCE *Short Answer* By number or words, order the following 3 choices from the one that travels the SLOWEST to the FASTEST: 1) sound in 0°C air; 2) electromagnetic radiation; 3) a spaceship at 5,000 meters per second

ANSWER: 1, 3 , 2 (ACCEPT: SOUND IN 0°C AIR; A SPACESHIP AT 5,000 METERS PER SECOND; ELECTROMAGNETIC RADIATION)

TOSS-UP

2) EARTH SCIENCE *Multiple Choice* Which of the following is the general term for metamorphic rocks whose mineral crystals are oriented in parallel layers, such as in a high-grade metamorphic rock:

- W) clastic
- X) foliated
- Y) intrusive
- Z) extrusive

ANSWER: X) FOLIATED

BONUS

2) EARTH SCIENCE *Multiple Choice* Which of the following is a high-grade foliated metamorphic rock:

- W) geode
- X) marble
- Y) gneiss
- Z) slate

ANSWER: Y) GNEISS

TOSS-UP

3) MATH *Short Answer* Provide the prime factors over the integers for the following expression:
 $x^3 + 8$

ANSWER: $(x + 2)$ and $(x^2 - 2x + 4)$ (DO NOT ACCEPT $(x + 2)$ times $(x^2 - 2x + 4)$)

BONUS

3) MATH *Short Answer* In how many different ways can a team of 6 students be selected from a group of 10 students?

ANSWER: 210

(Solution: ${}_n C_r = n!/[r!(n-r)!] = 10!/[6!(10 - 6)!] = 210$)

TOSS-UP

4) GENERAL SCIENCE *Multiple Choice* Which of the following types of scientists would most likely use interferometry in their experiments:

- W) astronomer
- X) plastics engineer
- Y) chemical engineer
- Z) microbiologist

ANSWER: W) ASTRONOMER

BONUS

4) GENERAL SCIENCE *Multiple Choice* Which of the following is currently the MOST popular method of making very large telescopes with immense abilities to detect very faint light sources in deep outer space:

- W) launching large parts of telescopes and assembling them in outer space
- X) linking multiple telescopes on Earth by computers
- Y) using a new form of ceramic glass to pour mirrors with diameters greater than 15 meters
- Z) using ultra-light carbon-fiber reinforced mirrors

ANSWER: X) LINKING MULTIPLE TELESCOPES ON EARTH BY COMPUTERS

TOSS-UP

5) LIFE SCIENCE *Multiple Choice* Gary the gardener raises a species of annual flowers that can produce pink or white flowers. Gary buys a pot of white flowers and plants them in his garden and each successive year saves only that year's generation of seeds to plant the next year. Over many generations of years of flowers Gary only ever sees white flowers. Which of the following is the BEST explanation for this breeding pattern:

- W) the original plant was homozygous dominant
- X) the original plant was homozygous recessive
- Y) the original plant was heterozygous for both colors
- Z) the original plant was homozygous but Gary cannot know for sure whether it is a dominant or recessive color

ANSWER: Z) THE ORIGINAL PLANT WAS HOMOZYGOUS BUT GARY CANNOT KNOW FOR SURE WHETHER IT IS A DOMINANT OR RECESSIVE COLOR

BONUS

5) LIFE SCIENCE *Short Answer* If $2n$ is the content of chromosomes in a normal non-sex cell and $2s$ is the DNA content of the same cell, what would be the values of n and s at the beginning of metaphase in mitosis?

ANSWER: $2n$ AND $4s$

TOSS-UP

6) PHYSICAL SCIENCE *Multiple Choice* Which of the following statements is TRUE of buffers:

- W) all neutral pH solutions have equal numbers of buffers
- X) hydronium ions are present in large amounts in most buffers
- Y) certain buffers will absorb hydrogen ions to prevent a change in a solution's pH
- Z) buffers are artificial chemicals rarely found in nature

ANSWER: Y) CERTAIN BUFFERS WILL ABSORB HYDROGEN IONS TO PREVENT A CHANGE IN A SOLUTION'S PH

BONUS

6) PHYSICAL SCIENCE *Short Answer* Considering that the atomic mass of sodium is 23 and the atomic mass of chlorine is 35, what is the molarity of a solution where 116 grams of sodium chloride are added to 1,000 milliliters of water?

ANSWER: 2

(Solution: $35 + 23 \rightarrow 116 = 2$ moles of NaCl in 1 liter = 2 molar)

TOSS-UP

7) EARTH SCIENCE *Multiple Choice* What type of data ultimately convinced geologists that Wegener's theory of continental drift was correct:

- W) paleomagnetic data
- X) well-preserved dinosaur fossils in Antarctica
- Y) detailed sonar imaging of the mid-Atlantic ridge
- Z) direct sampling and analysis of mantle material

ANSWER: W) PALEOMAGNETIC DATA

BONUS

7) EARTH SCIENCE *Multiple Choice* Which of the following seismic waves causes rock particles to move back and forth in the same direction as the wave is moving, much like the wave propagation in an outstretched spring that is hit on one end:

- W) L-waves
- X) P-waves
- Y) S-waves
- Z) T-waves

ANSWER: X) P-WAVES

TOSS-UP

8) MATH *Short Answer* In what quadrant will a 1135° angle lie, assuming it is in standard position?

ANSWER: ONE (ACCEPT: FIRST)

BONUS

8) MATH *Short Answer* Consider a smaller circle drawn within a larger circle. If the diameter of the larger circle is 10 centimeters and the diameter of the smaller circle is 6 centimeters, what is the area of the space between the two circles, giving your answer in square centimeters to the nearest whole number?

ANSWER: 50

TOSS-UP

9) GENERAL SCIENCE *Multiple Choice* Which of the following must occur for total internal reflection to occur:

- W) the angle of incidence equals the angle of reflection
- X) dispersion of all wavelengths of light
- Y) the critical angle of refraction is exceeded
- Z) polarized light must be used

ANSWER: Y) THE CRITICAL ANGLE OF REFRACTION IS EXCEEDED

BONUS

9) GENERAL SCIENCE *Short Answer* Which one of the following 5 materials has the smallest critical angle causing light entering it to be more likely to undergo total internal reflection: pure water; a near perfect vacuum; diamond; Lucite; 100% ethanol

ANSWER: DIAMOND

TOSS-UP

10) LIFE SCIENCE *Short Answer* In the wall of the human heart's right atrium is an area which sets the rate of heart beats. What is the common name for this area?

ANSWER: PACEMAKER

BONUS

10) LIFE SCIENCE *Multiple Choice* Which of the following is the BEST description for the location of the human spleen:

- W) lower right abdomen just above the hip bone
- X) upper right abdomen just under the lower right ribs
- Y) lower left abdomen just above the hip bone
- Z) upper left abdomen just under the lower left ribs

ANSWER: Z) UPPER LEFT ABDOMEN JUST UNDER THE LOWER LEFT RIBS

TOSS-UP

11) PHYSICAL SCIENCE *Multiple Choice* Which of the following is the BEST description of a colloid:

- W) a homogeneous mixture of uniform particles in solution
- X) a mixture of different substances that never settle out of solution
- Y) ionized particles in suspension
- Z) unfilterable suspended solutions

ANSWER: X) A MIXTURE OF DIFFERENT SUBSTANCES THAT NEVER SETTLE OUT OF SOLUTION

BONUS

11) PHYSICAL SCIENCE *Short Answer* An alpha particle is made of how many protons and how many neutrons?

ANSWER: 2 AND 2

TOSS-UP

12) EARTH SCIENCE *Short Answer* An alpine glacier generally has 2 areas, an accumulation zone and an area of net loss where the previous winter's snow melts away. What is the specific name for this zone?

ANSWER: ABLATION (ACCEPT: ABLATION ZONE or ABLATION AREA)

BONUS

12) EARTH SCIENCE *Multiple Choice* Which of the following is NOT true about Earth's atmosphere:

- W) carbon monoxide is found in trace amounts in Earth's atmosphere at sea level
- X) nitrogen and oxygen make up nearly 99% of Earth's atmosphere at sea level
- Y) temperatures in parts of the stratosphere are nearly as warm as they are on Earth
- Z) the tropopause is lower at the equator than at the north pole

ANSWER: Z) THE TROPOPAUSE IS LOWER AT THE EQUATOR THAN AT THE NORTH POLE

TOSS-UP

13) MATH *Short Answer* Solve the following logarithmic equation for x : $\log_x \frac{1}{25} = -2$

ANSWER: 5

BONUS

13) MATH *Short Answer* Find the surface area, in terms of pi in inches squared, of a closed right circular cylinder given that its radius is 3 inches and its length or height is 10 inches:

ANSWER: 78π

(Solution: $SA = 2\pi r^2 + 2\pi rh$; $SA = 2(\pi)(3^2) + 2(\pi)(3)(10) = 78\pi$)

TOSS-UP

14) GENERAL SCIENCE *Multiple Choice* Which of the following BEST describes the position of a waxing nearly half Moon just after an April sunset in Mississippi:

- W) low in the east
- X) low in the west
- Y) high in the southern sky
- Z) high in the northern sky

ANSWER: Y) HIGH IN THE SOUTHERN SKY

BONUS

14) GENERAL SCIENCE *Multiple Choice* Which of the following stars would have the hottest surface temperature:

- W) Blue Giant
- X) Red Supergiant
- Y) red dwarf
- Z) brown dwarf

ANSWER: W) BLUE GIANT

TOSS-UP

15) LIFE SCIENCE *Multiple Choice* Which of the following are the sugar transporting cells of the phloem in flowering plants:

- W) tracheids
- X) collenchyma
- Y) vessel elements
- Z) sieve tube cells

ANSWER: Z) SIEVE TUBE CELLS

BONUS

15) LIFE SCIENCE *Short Answer* Name all of the following 5 plants or plant groups that produce true flowers: sphagnum moss; fern; monocots; pine tree; cactus

ANSWER: MONOCOTS AND CACTUS

TOSS-UP

16) PHYSICAL SCIENCE *Multiple Choice* Which of the following is NOT true about phase changes in substances:

- W) energy is exchanged during a phase change
- X) sublimation is a type of phase change involving solids
- Y) freezing is an exothermic phase change
- Z) a phase change cannot be reversed

ANSWER: Z) A PHASE CHANGE CANNOT BE REVERSED

BONUS

16) PHYSICAL SCIENCE *Short Answer* Of the following 3 forms of radioactive decay, which one is the MOST penetrating in human tissue and which one is the LEAST penetrating, respectively: alpha; beta; gamma

ANSWER: MOST = GAMMA; LEAST = ALPHA

TOSS-UP

17) EARTH SCIENCE *Multiple Choice* There are 4 new statues in a park in New York city. The statue composed of which of the following materials will most likely deteriorate by chemical weathering the quickest:

- W) granite
- X) marble
- Y) slate
- Z) schist

ANSWER: X) MARBLE

BONUS

17) EARTH SCIENCE *Short Answer* If you could dive from the ocean surface to the abyssal plain, name all of the following 4 choices that would typically be INCREASED at the abyssal plain: pressure; density; salinity; temperature

ANSWER: PRESSURE; DENSITY; SALINITY (ACCEPT: ALL BUT TEMPERATURE)

TOSS-UP

18) MATH *Multiple Choice* Which of the following is the equation of a parabola whose graph opens downward:

- W) $y = -x^2$
- X) $y = x^3$
- Y) $y = x^2 + 2$
- Z) $y = x^2 - 2$

ANSWER: W) $y = -x^2$

BONUS

18) MATH *Short Answer* A rectangular water storage tank measures 30 meters long, 10 meters wide and 12 meters deep. If water is leaking out at a constant rate of 0.5 cubic meters per minute, how many hours will it take for the water level to drop one meter?

ANSWER: 10

(Solution: $300\text{m}^3 / (0.5\text{m}^3/\text{min}) = 600 \text{ min} / (60 \text{ min/hr}) = 10 \text{ hrs}$)

TOSS-UP

19) GENERAL SCIENCE *Multiple Choice* Which of the following household objects is an example of a heat pump:

- W) electric baseboard heater
- X) plasma TV
- Y) microwave
- Z) refrigerator

ANSWER: Z) REFRIGERATOR

BONUS

19) GENERAL SCIENCE *Short Answer* Of the following 4 choices, name all that are amino acids: tryptophan; testosterone; cholesterol; niacin

ANSWER: TRYPTOPHAN

TOSS-UP

20) LIFE SCIENCE *Multiple Choice* Differentiation of cells during plant development is MOST commonly associated with:

- W) cellular maturation into specialized cells
- X) enlargement of cells without specialization
- Y) division of cells without specialization
- Z) allowing cells to recognize other cells

ANSWER: W) CELLULAR MATURATION INTO SPECIALIZED CELLS

BONUS

20) LIFE SCIENCE *Short Answer* During early metaphase of mitosis, how many chromatids will be present in a single human cell?

ANSWER: 92

(Solution: 2 chromatids/chromosome $\rightarrow 46 \times 2 = 92$)

TOSS-UP

21) PHYSICAL SCIENCE *Short Answer* What gas law states that the volume of a gas is inversely proportional to its pressure as long as the temperature and number of particles are constant?

ANSWER: BOYLE'S (LAW)

BONUS

21) PHYSICAL SCIENCE *Short Answer* Name all of the following 3 chemical compounds that are substituted hydrocarbons: CH₄; CO₂; CH₃Br

ANSWER: CH₃Br

TOSS-UP

22) EARTH SCIENCE *Short Answer* From the following list of 4 scales, name all that are NOT used by geologists to measure earthquakes: Beaufort scale; Richter scale; Modified Mercalli scale; Saffir-Simpson scale

ANSWER: BEAUFORT SCALE; SAFFIR-SIMPSON SCALE

BONUS

22) EARTH SCIENCE *Short Answer* Order the following 3 stages of a stars development from the EARLIEST to the LATEST: Red Giant; white dwarf; main sequence star

ANSWER: MAIN SEQUENCE; RED GIANT; WHITE DWARF

TOSS-UP

23) MATH *Short Answer* If the discriminant, of a quadratic equation is negative, how many real solutions does the equation have?

ANSWER: 0

BONUS

23) MATH *Short Answer* Find the 21st term in the arithmetic sequence whose second term is -5 and fourth term is 7:

ANSWER: 109

TOSS-UP

24) GENERAL SCIENCE *Short Answer* Your boat shows a compass direction of 61 degrees and your navigation chart shows a variation of 12 degrees east. If you know your deviation is zero, what is your true course, in degrees?

ANSWER: 73

BONUS

24) GENERAL SCIENCE *Short Answer* The time aboard a ship at sea is 12 noon. If at the same time, the time at the Prime Meridian time is 4 PM, what is the ship's most likely longitude, in degrees and as east or west?

ANSWER: 60° WEST

TOSS-UP

25) LIFE SCIENCE *Short Answer* Which one of the following 5 molecules is a fibrous molecule that is very common in locations in between cells of the human body: cellulose; albumin; insulin; collagen; hemoglobin

ANSWER: COLLAGEN

BONUS

25) LIFE SCIENCE *Short Answer* Which 2 of the following 5 molecules are most directly involved in muscle contraction in mammals: cellulose; albumin; actin; collagen; myosin

ANSWER: ACTIN; MYOSIN